At Department of Energy, Neutrons Matter

Agency uses advanced visualization to build
neutron source containing the best and brightest

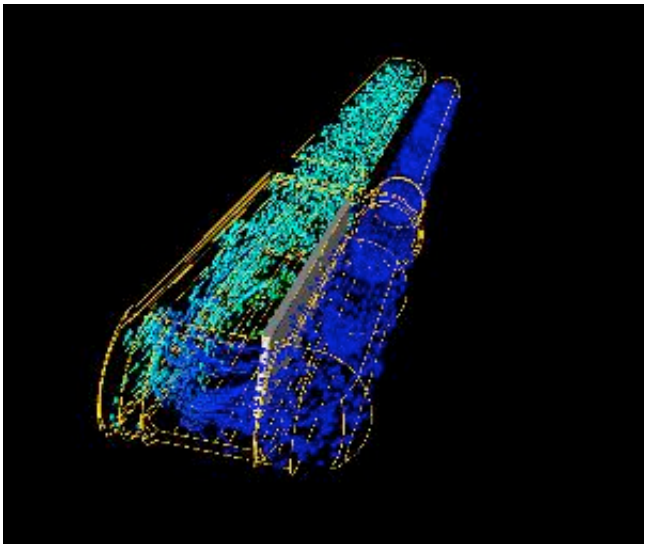
by Anna Turnage

Your credit card; your calculator; the jet you took on a business trip last week; the medical tests your doctor ordered this morning.

All these things are a big part of your life at some time or another. But, it's the little things that make them all possible – the neutrons – those tiny particles that make up matter.

Most of us are so busy going about our daily lives that we don't think about the role of neutrons. But the officials and scientists with the Department of Energy know that improvements in technology can't continue without neutron scattering research.

This research has been used to make our cars more fuel efficient and environmentally friendly. It has made aircraft faster while using less fuel. And it has helped medical professionals and scientists with genetic engineering and the creation of new drugs.



EnSight is helping DOE scientists test its Spallation Neutron Source

Only the Brightest

With the help of EnSight visualization software from CEI (Morrisville, N.C.), the DOE is working to build the most advanced and powerful neutron source in the world.

Called the Spallation Neutron Source (SNS), it will provide research capabilities not available anywhere in the world. Neutron spallation is the process by which a fast particle strikes an atomic nucleus, causing the neutrons to be knocked out for use in research. Although neutrons make up half of all visible matter, scientists need those of a specific "brightness" with which to conduct research. The SNS will supply 10 times more of the specific neutrons needed for research than any other source.

The project is being constructed under a partnership of the six DOE national laboratories – Oak Ridge, Argonne, Brookhaven, Jefferson, Lawrence Berkeley and Los Alamos. The facility will be located at Oak Ridge National Laboratory, where scientists are using computational fluid dynamics (CFD) to model the flow of fluid and heat to predict temperatures, velocities and pressures within the SNS target.

A Graphical Understanding

"In the case of the SNS we are interested in temperatures within the ‘target,’ which is bombarded by protons at a very high energy deposition rate," says Mark Wendel, heat transfer/fluid flow specialist with Oak Ridge. "Liquid mercury is circulated through the target box to provide a material from which the protons can spallate neutrons, and to remove the heat from the proton beam."

EnSight visualization capabilities are vital in properly interpreting the predicted results and in working out problems with the SNS CFD model, he says.

"The mathematical model has millions of numbers that must be computed and cannot be adequately understood without being able to visualize them graphically," Wendel says. "We have used EnSight to visualize the predicted fluid flow and heat transfer in the target. This process helps us to determine problems or errors with the model and to understand the physics of the flow field."

EnSight’s keyframe animation makes it easy to produce visualizations that span time and events. Its interface with CFX4, the CFD code, also makes it ideal for the SNS project, according to Wendel.

"We can observe secondary flow patterns in the animations that are not evident from still graphics. By visualizing the fluid flow as an animation, we can identify problems with the target design and recommend design changes that will keep the target at lower temperatures."

Wendel says EnSight has been especially useful in presentations about the SNS project. He has been able to show the results of the tests using .avi files, created directly in EnSight.

The project is scheduled to be completed in 2006 and SNS will be open to scientists and researchers from all six government labs, as well as universities and industries worldwide.

Through the power of advanced visualization, SNS will help researchers continue to discover how the smallest particles can lead to big advances in the technological, biological and material worlds.

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